

REMARKS/ARGUMENTS

Favorable reconsideration of this application, as presently amended and in light of the following discussion, is respectfully requested.

Claims 1-5, 7-9, 11-24, and 27-32 are pending in the present application. Claims 1, 2, 4, and 5 have been amended by the present response, and support for the amendments is found in the Applicants' specification at page 5, line 33 to page 6, line 1, as well as Figures 2 and 6. Claims 29-32 are newly added by this amendment, and support for the newly added claims is found in previously presented Claims 1, 2, 4, and 5. It is respectfully submitted that no new matter is added by this amendment.

In the outstanding Office Action, Claims 1-5, 7-9, 11-24, and 27-28 were provisionally rejected under the judicially created doctrine of obviousness-type double patenting as being unpatentable over Claims 1-28 of copending U.S. Application No. 10/387,452; Claims 1-4, 9, 21-23, and 27-28 were rejected under 35 U.S.C. §102(b) as anticipated by Kubota et al. (U.S. Patent No. 5,643,483, hereinafter Kubota); Claims 5, 7, 11, and 24 were rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Miyata (U.S. Publication Number 2002/0021730); Claims 5, 7, and 11 were rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Noda et al. (U.S. Patent Number 5,753,893, hereinafter Noda); Claim 8 was rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Yamada et al. (U.S. Patent Number 5,998,320, hereinafter Yamada); Claims 5 and 12 were rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Yamada; Claims 13-15 were rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Ushikawa et al. (U.S. Patent Number 6,140,256, hereinafter Ushikawa); Claim 16 was rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Miyata or Noda, and further in view of Ushikawa; Claim 19 was rejected under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Nozaki et al. (U.S. Patent Number 5,264,681,

hereinafter Nozaki); and Claim 20 was rejected under 35 U.S.C. §103(a) as being unpatentable over Kubota in view of Miyata or Noda, and further in view of Nozaki.

Applicants thank Examiner Fastovsky for the interview granted Applicants' representatives on March 16, 2005. During the interview, the claimed invention was discussed with respect to the cited references. Further, in light of the interview the Applicants respectfully request that the results of the comparative examples discussed below and included in the Applicants' specification on page 26, line 5 to page 39, line 23 be considered as objective evidence of nonobviousness under M.P.E.P. §716.01(a). The present response sets forth the claim amendments and arguments previously discussed during the interview.

Before turning to the outstanding art rejections, it is believed that a brief review of the invention would be helpful. The present invention relates to a ceramic heater including a ceramic substrate having a work-heating surface and a heating element disposed either on a surface of the ceramic substrate opposite to the work-heating surface or in the ceramic substrate. The work-heating substrate is configured "to contact directly with a work to be heated or to face a work to be heated across a space between the work-heating surface and the work to be heated." In amended Claim 1, the work-heating surface "has a JIS B 0601 surface roughness of $R_{max} = 0.05$ to $200\text{ }\mu\text{m}$;" in amended Claim 2, "said ceramic substrate contains an element other than its dominant constituent elements and the work-heating surface has a JIS B 0601 surface roughness of $R_{max} = 0.2$ to $200\text{ }\mu\text{m}$;" in amended Claim 4, the ceramic substrate is a nitride ceramic substrate, and "said nitride ceramic substrate contains an element other than its principal constituent elements and the work-heating surface has a JIS B 0601 surface roughness of $R_{max} = 0.2$ to $200\text{ }\mu\text{m}$;" and in amended Claim 5, "said nitride ceramic substrate contains at least one element selected from Na, B, Y, Li, Rb, and Ca and the work-heating surface has a JIS B 0601 surface roughness value of $R_{max} = 0.2$ to 200

μm .” Further, amended Claims 1, 2, 4, and 5 recite that “the surface opposite to the work-heating surface of the ceramic substrate is flat.”

Through the inventors’ own inventive efforts, the cause-and-effect relationship between the surface roughness of the work-heating surface and obtaining a uniform temperature of the work was discovered, thereby achieving an innovative ceramic heater which can heat the work to a uniform temperature by adjusting the surface roughness R_{max} of the work-heating surface within a specified range.

If the surface roughness of the work-heating surface is too small, the area of contact between the work and the work-heating surface becomes too large when the work is placed and heated on the work-heating surface. The temperature difference in the work-heating surface is reflected to the work, and the temperature difference in the work becomes large (see appended Fig. 1B). Even when the work is held apart from the work-heating surface, the atmospheric gases (air, reactive gas, and the like) between the work and the work-heating surface flow easily to the work and deprive the work of heat, and the result is that a temperature difference is generated in the work (see appended Fig. 1D).

Conversely, if the surface roughness of the work-heating surface is too large, atmospheric gases remain in the spaces among the irregularities of the work-heating surface (valleys) or at the spaces between the work and the work-heating surface. This causes accumulation of heat and leads to a large temperature difference of the work (see appended Figs. 1A and 1C).

The above effects are shown in a comparison of exemplary examples included in the Applicants’ specification. In exemplary Comparative Example 7, wherein R_{max} is $210\ \mu\text{m}$, the temperature difference of the work, that is, the difference between the highest and the lowest temperatures was as big as 8°C .¹ In exemplary Comparative Example 6, R_{max} is as

¹ Applicants’ specification, page 36, lines 26 to 31 (results are shown in Table 2 on page 39).

small as $0.03\text{ }\mu\text{m}$, but the difference between the highest and the lowest temperatures was also as big as $8\text{ }^{\circ}\text{C}$.² Conversely, in the corresponding exemplary examples, the temperature differences of the work were small: in Example 8 with ($R_{\text{max}} = 0.08\text{ }\mu\text{m}$), the difference was 4°C ; in Example 9 ($R_{\text{max}} = 6\text{ }\mu\text{m}$), it was 3°C ; in Example 10 ($R_{\text{max}} = 180\text{ }\mu\text{m}$), it was 4°C . The Applicants respectfully submit that the results of the above-described comparative examples is objective evidence of nonobviousness under M.P.E.P. §716.01(a). Further, the importance of the dependency of the relationship between the surface roughness of the work-heating surface and uniform heating of the work is clear from the above results, and these comparative results must be given weight as evidence, not mere arguments. See In re Margolis, 228 U.S.P.Q. 940 (Fed. Cir. 1986). It is further noted that evidence of superiority, like these comparative examples, is enough to establish nonobviousness. See In re Chupp, 2 U.S.P.Q. 2d 1437, 1439 (Fed. Cir. 1987). Therefore, as the above discussed effect of the present invention is unexpected and not found in any of the cited references, the withdrawal of the rejections in the outstanding Action is believed to be in order.

The rejection of Claims 1-4, 9, 21-23, and 27-28 under 35 U.S.C. §102(b) as anticipated by Kubota is respectfully traversed.

Kubota describes a ceramic heater including a substrate plate that has two opposite facing surfaces and is made of an electrically insulating ceramic material such as fused silica glass.³ Kubota states on column 3, lines 48-52 that “it is essential according to the invention that the surface of the substrate plate, on which the electric heater layer is formed from an electroconductive heat-resistant material, is imparted with a surface roughness R_{max} in the range from $2\text{ }\mu\text{m}$ to $200\text{ }\mu\text{m}$.” Further, Kubota states that the surface opposite to roughened surface on which the electric heater layer is formed “should preferably be as smooth as possible because a smooth surface is advantageous in respect of the better heat transfer from

² Applicants’ specification, page 29, lines 21 to 25 (results are shown in Table 2 on page 39).

³ Kubota, column 2, lines 20-33.

the ceramic heater to the workpiece thereon and less contamination by the deposition of foreign materials than otherwise.” In other words, Kubota defines the surface roughness R_{max} of the surface opposite to the wafer heating surface, and indicates the wafer heating surface should be as smooth as possible. Conversely, according to the present invention (amended Claims 1, 2, 4, and 5), the surface roughness R_{max} of the work-heating surface is in the range 0.05 to 200 μm and the surface opposite the work-heating surface is flat. Therefore, it is respectfully submitted that Kubota fails to disclose, teach, or suggest the ceramic substrate of amended independent Claims 1, 2, 4, and 5, wherein “the surface opposite to the work-heating surface is flat” and the “work-heating surface which is configured to contact directly with a work to be heated or to face a work to be heated across a space between the work-heating surface and the work to be heated” has a specified surface roughness R_{max} within the range of 0.5 to 200 μm .

Accordingly, it is respectfully submitted that Kubota fails to disclose each and every element of amended Claims 1, 2, and 4, and it is respectfully requested that the rejection of Claims 1, 2, and 4 be withdrawn.

Likewise, it is respectfully submitted that dependent Claims 3, 9, 21-23, and 27-28 patentably distinguish over Kubota at least because of their dependent recitation of the above identified features of amended Claim 1, 2, and 4. Therefore, it is also respectfully requested that the rejection of dependent Claims Claims 3, 9, 21-23, and 27-28 also be withdrawn.

The rejection of Claims 5, 7, 11, and 24 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Miyata is also traversed.

As described above, Kubota fails to teach, or suggest the ceramic substrate of amended independent Claims 1, 2, 4, and 5, wherein “the surface opposite to the work-heating surface is flat” and the “work-heating surface which is configured to contact directly with a work to be heated or to face a work to be heated across a space between the work-

heating surface and the work to be heated” has a specified surface roughness R_{max} within the range of 0.05 to 200 μm . Further, amended Claims 2, 4 and 5 recite that “the work-heating surface has a JIS B 0601 surface roughness value of $R_{max} = 0.2$ to 200 μm .” Kubota discloses at column 4, lines 5-16, that the surface for mounting the workpiece to be heated may have a surface roughness R_{max} in the range of 0.01 to 0.1 μm , but this outside of the range specified in Claims 2, 4 and 5. Further, Kubota teaches away from a work-heating surface having a surface roughness within the range $R_{max} = 0.2$ to 200 μm as recited in amended Claims 2, 4 and 5, stating that the surface opposite to roughened surface on which the electric heater layer is formed “should preferably be as smooth as possible because a smooth surface is advantageous in respect of the better heat transfer from the ceramic heater to the workpiece thereon and less contamination by the deposition of foreign materials than otherwise.”⁴

Miyata discloses “An electric heating element having a structure comprising an electric insulating nitride or carbide ceramic substrate and an electrically heat-generating material film having a microstructure composed of silicide alone, a mixture of a silicide and Si, or Si alone, said film being fused to the surface of said electric insulating ceramic substrate.”⁵ Further, Miyata discloses an electrostatic chuck having a structure comprising an electrostatically chucking mechanism provided with a dielectric ceramic and an electrode formed on the bottom face of said dielectric ceramic and a heating mechanism coupled with the bottom face of said electrostatically chucking mechanism, said heating mechanism having a structure comprising two electric insulating ceramic substrates having the same or nearly the same linear expansion coefficients and a fusible electric-heating material film interposed between said substrates, said film being fused to said substrates.⁶ However, Miyata does not

⁴ Kubota, column 4, lines 8-13.

⁵ Miyata, page 2, paragraph 31.

⁶ Miyata, page 2, paragraphs 40-41.

teach or suggest the claimed surface roughness, R_{max} , of the heating surface. Therefore, Miyata does not cure the deficiencies as discussed above with respect to Kubota.

Therefore, it is respectfully requested that the rejection to independent Claim 5 and Claims 11 and 24 depending therefrom be withdrawn.

Likewise, it is respectfully requested that Claim 7, which depends from amended Claim 4, also be withdrawn.

The rejection of Claims 5, 7, and 11 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Noda is similarly traversed.

Noda discloses a ceramic heater having a resistance heater and a sintered material comprising Al_2O_3 , SiO_2 , MgO and CaO , and further comprising 0.3 to 13% by weight of at least one oxide of an element selected from the group consisting of Zr, Y, Hf, Nb, and Ta.⁷ Figures 1 and 2 show a planar plate-shaped heater and a round-rod shaped heater. However, Noda does not teach anything about the claimed surface roughness, R_{max} , of the work-heating surface. Therefore, Noda also fails to cure the deficiencies of Kubota with respect to amended independent Claims 4 and 5.

Accordingly, it is respectfully requested that this rejection of Claim 5 under 35 U.S.C. §103(a) in view of Kubota and Noda be withdrawn.

Likewise, it is respectfully requested that the rejections of Claims 7 and 11 depending from Claims 4 and 5, respectively, also be withdrawn.

The rejection of Claims 5, 8, and 12 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Yamada is also traversed.

Yamada discloses an aluminum nitride sintered body comprising aluminum nitride and less than 100 ppm of metal elements other than aluminum, wherein the sintered body has a volume resistivity at room temperature greater than $1.0 \times 10^9 \Omega \cdot cm$ and smaller than $1.0 \times$

⁷ Noda, column 2, lines 22-55 and column 9, lines 22-28.

$10^{13} \Omega \cdot \text{cm}$.⁸ However, Yamada is silent about the surface roughness, R_{max} , of the work-heating surface. Therefore, Yamada does not cure the deficiencies of Kubota as discussed above with respect to amended independent Claims 4 and 5.

Accordingly, it is respectfully requested that this rejection of Claim 5 under 35 U.S.C. §103(a) in view of Kubota and Yamada be withdrawn.

Likewise, it is respectfully requested that the rejections of Claims 8 and 12 depending from Claims 4 and 5, respectively, also be withdrawn.

The rejection of Claims 13-15 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Ushikawa is also respectfully traversed.

Ushikawa relates to an apparatus for processing semiconductor wafers. According to Ushikawa, the bottom surface of a wafer can be positioned above the mount surface of the apparatus by a distance of 0.5 mm to 2 mm.⁹ However, Ushikawa is silent about the surface roughness, R_{max} , of the mount surface. Further, Ushikawa does not teach or suggest the cause-and-effect relationship between the surface roughness of the mount surface and obtaining a uniform temperature of the work. Therefore, Ushikawa does not remedy the deficiencies of Kubota as discussed above with respect to amended independent Claims 1, 2, and 4 from which Claims 13-15 depend. Accordingly, the subject matter of Claims 13-15 is not obvious over Kubota in view of Ushikawa.

Therefore, it is respectfully requested that the rejection of Claims 13-15 also be withdrawn.

The rejection of Claim 16 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Miyata or Noda, and further in view of Ushikawa is also respectfully traversed.

As discussed above, none of references Miyata, Noda, or Ushikawa, either alone or in any proper combination cure the deficiencies of Kubota with respect to amended independent

⁸ Yamada, Abstract.

⁹ Ushikawa, column 4, lines 33-36.

Claim 5. Therefore, it is respectfully submitted that Claim 16 is allowable over the cited references at least because of the Claim 16 dependent recitation of the above-identified features of amended independent Claim 5.

Accordingly, it is respectfully requested the rejection of dependent Claim 16 be withdrawn.

The rejection of Claim 19 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Nozaki is also respectfully traversed.

Nozaki is directed to a ceramic heater for use as a glow plug for a diesel engine or as an igniter for an oil or gas burner. The ceramic heater has a nonoxide ceramic body having a supporting part and a heating part embedded with a heating resistor.¹⁰ However, Ushikawa is silent about the surface roughness, R_{max} , of the work-heating surface.

Therefore, Nozaki fails to cure the deficiencies of Kubota with respect to amended independent Claim 4 from which Claim 19 depends. Accordingly, it is respectfully submitted that Claim 19 is allowable for at least the same reasons as discussed above with respect to amended independent Claim 4. Therefore, it is also respectfully requested that the rejection of Claim 19 be withdrawn.

The rejection of Claim 20 under 35 U.S.C. §103(a) as unpatentable over Kubota in view of Miyata or Noda, and further in view of Nozaki is also respectfully traversed.

As discussed above, none of cited references Miyata, Noda, or Nozaki, either alone or in any proper combination cure the deficiencies of Kubota with respect to amended independent Claim 5. Therefore, it is respectfully submitted that Claim 20 is allowable over the cited references at least because of the Claim 20 dependent recitation of the above-identified features of amended independent Claim 5.

¹⁰ Nozaki, abstract.

Therefore, it is also respectfully requested that the rejection of Claim 20 be withdrawn.

In light of the amendments to independent Claims 1, 2, 4, and 5 and the above discussion, it is respectfully submitted that the “provisional” double patenting rejection is the only rejection remaining in the application. However, M.P.E.P. §804(I)(B) states the following:

[I]f the “provisional” double patenting rejection in one application is the only rejection remaining in that application, the examiner should then withdraw that rejection and permit the application to issue as a patent, thereby converting the “provisional” double patenting rejection in the other application(s) into a double patenting rejection at the time the one application issues as a patent.

Therefore, the Applicants respectfully request that the “provisional” double patenting rejection be withdrawn and this application be permitted to issue as a patent.

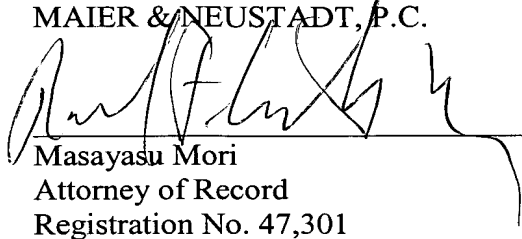
New Claims 29-32 recite a ceramic heater including a “ceramic substrate having a work-heating surface which is configured to face a work to be heated across a space between the work-heating surface and the work to be heated.” It is respectfully submitted that none of the cited references, either alone or in any proper combination, teach or suggest the above identified feature in combination with the other claimed features in new Claims 29-32. Accordingly, Applicants respectfully submit that these claims are likewise allowable.

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Reply to Office Action of December 16, 2004

As no further issues are believed to be outstanding in this application, it is respectfully submitted that the present application is believed to be in condition for formal allowance, and an early and favorable action to that effect is respectfully requested.

Respectfully submitted,

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